Active Project (2016 - 2017)

DEVELOPMENT OF THE INTEGRATED WATER RECOVERY ASSEMBLY (IRA) FOR RECYCLING HABITATION WASTEWATER STREAMS, Phase I Project

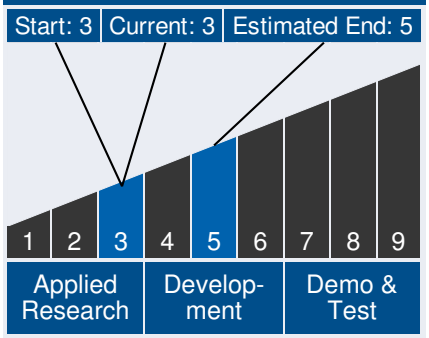
SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Paragon Space Development Corporation and our partner Research Institution Texas Tech University (TTU) propose to develop a spacecraft habitat wastewater recycling system that integrates 1) the TTU Membrane Aerated Biological Reactor (MABR), 2) Nafion Membrane Water Purification (NWP) distillation technology, and 3) gas-phase trace contaminant removal to realize a low-mass, low-volume, closed-loop, sustainable, and ultra-reliable water recycling and purification system. It is the coupling of these three well developed and understood processes that is novel and offers a significant advantage over state of the art (SOA) spacecraft water processing systems. The Integrated Water Recovery Assembly (IRA) will reduce consumable consumption by removing the need for hazardous chemical pretreat and likely eliminate the need for aqueous-phase treatment now used to reach potable standards. It will also significantly reduce waste generation and increase material recycling by converting carbon, hydrogen, and nitrogen species into useful products such as H2O, N2, and CO2. IRA will be less complex, require fewer consumables, be more robust, and more sustainable than SOA systems. IRA will also produce a concentrated and dried solid waste stream that is always contained and that will consist of salts and residual organic matter. MABR and NWP have developed as independent subcomponents for human spaceflight wastewater processing but their unique attributes have not been optimized to function together as an integrated wastewater recycling system. Neither is individually capable of producing potable water, but combined with gas phase trace contaminant control, we propose that IRA represents a significant advancement over SOA of the art spacecraft wastewater processing systems. In summary, the innovation we propose is to combine and optimize all three stages into a novel integrated system capable of processing habitation wastewater and producing clean water for all habitat needs.

Table of Contents

Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Continued on following page.

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ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Paragon's commercialization strategy for the development and incorporation of IRA into NASA's next microgravity or planetary habitat is summarized as follows: Technical Maturation - First and foremost a successful Phase I STTR must be completed. We must demonstrate improvement over SOA spacecraft wastewater recycling and we must identify a clear path towards inclusion into NASA's next human exploration vehicles. The Phase II effort must mature IRA and deliver a functional prototype that quantifies performance and advantages. Market Development - The primary near-term market for IRA is NASA's Human Spaceflight program. Paragon actively engages with NASA through funded technology development efforts such as proposed here, flight hardware production contracts to Lockheed Martin (Orion) and Boeing (CST-100), and through active participation of industry conferences and workshops. We believe the most promising near-term opportunity to inject IRA into an operational systems is to demonstrate a Phase III system at ISS in the 2020 timeframe. Demonstration at ISS would pave the way for IRA to be integrated with the exploration habitats that will ultimately be developed for NASA.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Potential Non-NASA aerospace customers include Boeing, Lockheed Martin, Orbital-ATK, Bigelow, & SpaceX. It is also possible that commercial entities like Inspiration Mars, Golden Spike, or Mars One could come through with significant investment funds for the maturation of their commercial exploration plans. Paragon is well positioned to incorporate IRA into their technical solutions as we have recent and ongoing work with entities such as this. In addition to aerospace applications, development of a highly regenerative and simple wastewater recycling system has

Management Team *(cont.)*

Program Manager:
- Carlos Torrez

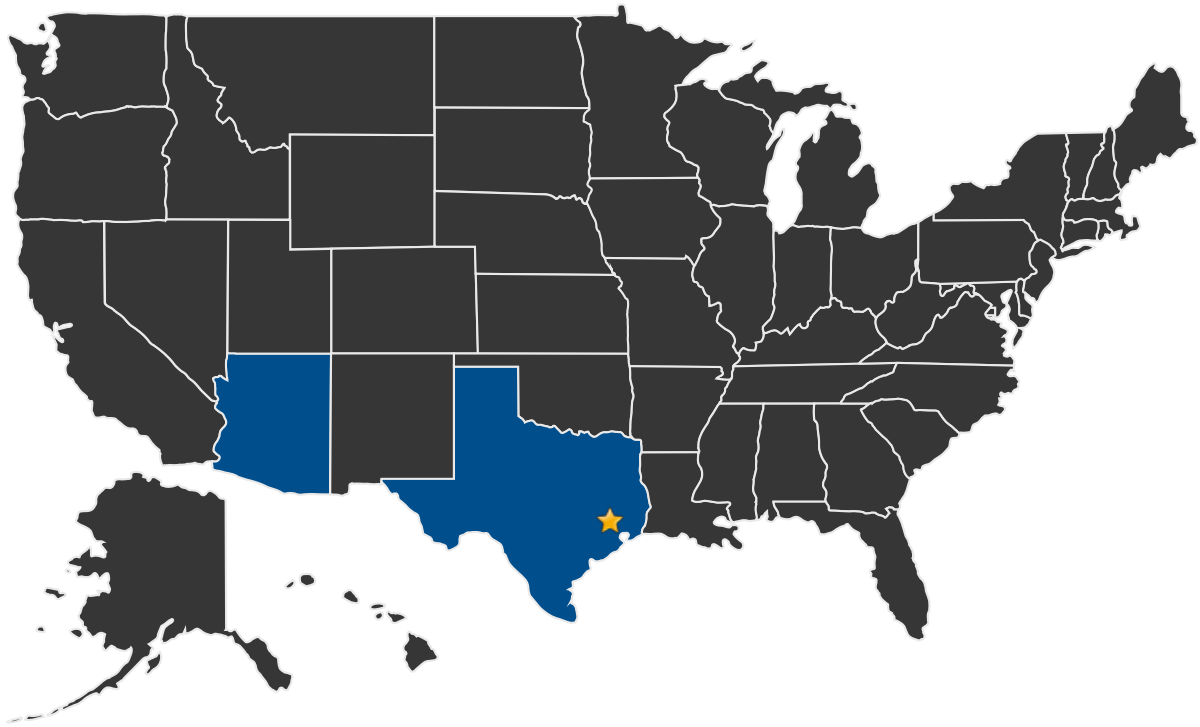
Principal Investigator:
- Barry Finger

Technology Areas

Primary Technology Area:
Human Health, Life Support, and Habitation Systems (TA 6)
- Environmental Control and Life Support Systems and Habitation Systems (TA 6.1)
  - Water Recovery and Management (TA 6.1.2)

numerous terrestrial applications, including disaster relief, remote military base support, and the deployment of green building hygiene water recycling systems. Paragon has the experience and technical capabilities and skills to mature IRA to flight in partnership with TTU and to market it for aerospace and terrestrial applications. We recognize it is essential to foster and develop business relations with customers, suppliers, and key subcontractors. To that end, we continue to develop a solid supplier base and have established working relationships with Research Institutions such as TTU that bring with them critical skills and capabilities of their own.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Johnson Space Center

Other Organizations Performing Work:

- Paragon Space Development Corporation (Tucson, AZ)
- Texas Tech University

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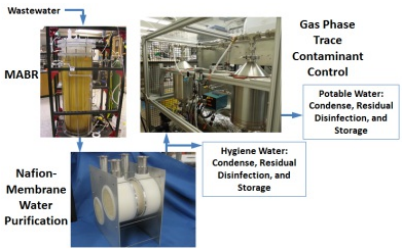
PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23248)

IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

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